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MONTANA ENVIRONMENTAL INDICATORS
THE EQC FOURTH ANNUAL REPORT

BY

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MONTANA ENVIRONMENTAL INDICATORS

The EQC Fourth Annual Report

Contents:

Introduction..... 1
The EQC Indicators Program Objectives..... 2
Initiating the EQC Indicators Program..... 4
Montana's Environmental Regions..... 5
Selecting Montana Environmental Indicators..... 14
Indicators Statewide: An Overview of Major Findings..... 16
Utilizing the Results..... 28
Conclusion..... 29

Map 1 Montana's Environmental Regions..... 31
Table 1 Distribution of Counties within Montana's Environmental Regions.....32, 33
Table 2 Environmental Monitoring in Montana..... 34
Table 3 Montana Environmental Indicators, 1975..... 35

This review of the EQC indicators program and summary of the EQC Fourth Annual Report was prepared for publication in Western Wildlands, Vol. 2 No. 4 (Autumn, 1975), a natural resources journal published by the Montana Forest and Conservation Experiment Station, University of Montana, Missoula, 59801.

An earlier discussion of the EQC indicators program was prepared by Loren L. Bahls in "Environmental Indicators: A Program for Montana," Proceedings of the Montana Academy of Sciences, Volume 35 (1976), pp. 1-10. In important respects, the EQC Fourth Annual Report was an integrated EQC staff effort. Richard L. Bourke, EQC staff economist, assembled data on energy, lands in forest, farms, and range, employment and income, and other areas. Steven J. Perlmutter, EQC staff attorney, contributed data on population size and distribution, and transportation. Charles E. Brandes, former land use analyst now with the California Governor's Office of Planning and Research, collected data on population changes, library circulation, and social services.

MONTANA ENVIRONMENTAL INDICATORS

THE EQC FOURTH ANNUAL REPORT

Introduction

A major responsibility of the Montana Environmental Quality Council (EQC) is to collect, analyze, and interpret data on the state of the state's environment and make it available to state decision makers, legislators, and citizens. As outlined in the Montana Environmental Policy Act (MEPA), this duty is premised on the firm belief that information on current trends and conditions of Montana's environment is required if Montanans are to understand the complex man-nature interactions taking place within the state as well as to use this information in making decisions affecting Montana's environment.

Montana will be subject to enormous forces of change in the coming years. To the extent Montanans can or want to guide these forces, they need accurate information on the state of the state's environment. These forces--the demand for Montana coal, growing materials shortages which will increase the demand for Montana minerals, the likely increase in demand for Montana agricultural products, the redistribution to more rural areas of people from large cities, and the ever increasing demand for high quality recreation--have significant implications for all Montanans, regardless of individual value judgments as to whether the changes coming are "good" or "bad".

The major premise upon which the EQC Fourth Annual Report is based is that maintenance of a high quality environment and fostering those conditions that allow man and nature to live in "productive harmony" require more than simple caring. Action is necessary and that action must be informed if it is to be effective. Information is a resource and like other resources, good information is often scarce. A major goal of the EQC indicators program is to reduce the costs of

getting coherent, accurate data on the full range of environmental trends in Montana. A longer term objective is to develop a statewide environment indicators system in the hope of making accurate environmental information more widely available and of having the information utilized by decision makers confronted with complex environmental issues.

The EQC Indicators Program Objectives

MEPA establishes a state policy for the environment that directs the state "to create and maintain conditions under which man and nature can coexist in productive harmony...." Implicit in this general directive to state government is the notion that resource decisions made now should be based not only on how they will affect the basic integrity of the ecosystem but also on how the use of those resources should be balanced to protect the rights of future generations to a clean and healthful environment. Such a policy implies that the maintenance of ecosystem integrity and the protection of the rights of future generations require a concerted effort directed at establishing state policies and programs whose objectives are to promote activities that are capable of being sustained over the very long term. Whether and how to do this are subjects of considerable complexity and produce a variety of conflicting opinions whenever they are discussed.

A major objective of the EQC Fourth Annual Report is to provide an information base from which these issues can be discussed intelligently and competently. In this sense, the EQC indicators program is designed to serve a reporting function as contrasted to an evaluative function. The report contains longitudinal data on some 30 indicators that reflect major facets of the Montana environment, broadly defined. Taken as a whole, the report contains current information on the state

of the state's environment. The report acknowledges that while no "scientific" basis for establishing aggregate measures of the "quality of life" exists, any effort to assess environmental trends and conditions must proceed from facts as opposed to intuition. This need for standard measurements exists even though people, depending on their situation in life and their individual preferences, may have quite different ideas of what ought to be and what is "good" or "bad".

Individuals and groups, whether private or public, need accurate information as each seeks to articulate and impose its verison of "the good life" on others. The need for accurate information is heightened as the issues surrounding growth and change become more complex and as more and more citizens exercise their legitimate rights to participate in resource allocation decisions.

The EQC Fourth Annual Report does not provide the answer to what must be done to ensure that man and nature can live in productive harmony. Neither does it offer a version of what "the good life" in Montana is or should be. Rather, its objective is to establish a process by which a statewide system of environmental indicators can be developed that will provide current, accurate, and usable information on changes (improvements as well as problems) occurring in Montana's environment. Such a system should be viewed as a tool, assisting those who wish, insofar as it is possible, to guide growth and change in the state.

Aside from this major objective, the indicators report has a number of other objectives and potential applications. These include serving as an early warning system, identifying environmental problems before they become crises with irreversible consequences. Another objective is to provide data that may be used to prepare environmental impact statements or conduct analyses of the various trade-offs attached to alternative developments. Lastly, the indicators

are designed to be used in conjunction with a review of state agency environmental programs. The indicators should provide data on environmental trends and issues and can be used to assess the effectiveness of programs undertaken to abate, resolve, or mitigate specific environmental problems.

Initiating the EQC Indicators Program

In July 1974, the EQC decided to make environmental indicators the theme of its Fourth Annual Report. The EQC was not new to this effort; the EQC's First Annual Report (1972) was a pathbreaking attempt to develop an ecologically sound framework for reporting data on Montana's environment. Once the decision was made to proceed with the indicators project, a number of activities was initiated.

- Dr. John M. Crowley, the University of Montana geographer who delineated the original Montana environmental regions presented in the First Annual Report, was asked to review his earlier work. He revised the map of Montana's environmental regions and expanded the description of the state's seven major environmental regions.
- Fletcher E. Newby, EQC executive director when the first EQC indicator effort was begun in 1971 and now deputy director of the Montana Department of Fish and Game, reassessed the first effort and made useful recommendations for improving subsequent reports.
- The EQC staff conducted a literature review of environmental indicator efforts. Here a major attempt was made to review the indicators work conducted by the President's Council on Environmental Quality, the National Wildlife Federation, and similar ongoing efforts taking place in other states.

- The EQC staff assembled information on what kinds of environmental data were being monitored by state and federal agencies in Montana.
- The EQC staff reviewed this information and established criteria for selecting the indicators to be included in this report, assembled the data, and reported it in draft form organized within the Montana environmental regional framework. Prior to publication as the EQC Fourth Annual Report, the material was extensively reviewed by the Environmental Quality Council and advisory committees representing state agencies and the Montana University System.

Montana's Environmental Regions

The task of reporting environmental indicators for Montana would be very simple if it were not for the extreme diversity of human habitats across the state. Diversity--in elevation, precipitation, vegetation, land use, and in a number of other variables--is the rule rather than the exception over the earth's surface and Montana is probably more diverse than most land areas its size. The first task of the indicators program was to delineate some natural and cohesive regional units within the state based upon principles of regional geography.

The utility of this approach can be illustrated by way of two brief examples. Indicators of the amount and quality of cropland would be of little interest or use to residents of northwestern Montana, where nine-tenths of the area is covered with forest but they would be quite relevant to residents of the Triangle area north of Great Falls. Similarily, a coal production indicator would have less significance in the Triangle area than it would in the coal-rich Fort Union Region. Human environmental regions also have utility

from the standpoint of carrying capacity. Although conceptually elegant, formal regional carrying capacity models rapidly break down because of technological innovation and inter-regional trade and transportation systems.

Montana's human environmental regions were developed by Professor John M. Crowley of the Department of Geography at the University of Montana in collaboration with the EQC staff. The system used to delineate the state's environmental regions was based on the recognition that our present human environment is the result of man's modification of the natural environment, which in turn is composed of a combination of biophysical components, the principal ones being land form, water availability, and vegetation. The natural resources inherent to a relatively homogeneous geographical area set limits on the combination of economic activities that can be practiced in that area. Human activities, i.e., farming, ranching, mining, logging, etc., are therefore geographically arranged in an orderly--as opposed to a haphazard--fashion, and the manifestion of these activities--the cultural landscape--is similarly ordered. Consequently, a particular kind of human habitat or environment is usually associated with certain other features to form a distinctive combination, such as the wheat fields, fallow fields, shortgrass rangeland and irrigated valleys in northeastern Montana. Such combinations of environments tend to recur throughout a broad area thereby giving rise to an environmental region that differs sharply from neighboring regions.

In summary, the principal criteria used to delineate Montana's environmental regions are land form, water regime, natural vegetation, and human land patterns superimposed upon each distinctive grouping of these natural conditions. The regions established in this manner are shown on Map 1. It should be remembered that the regions do not end at the state line, but continue on into

NOTE: See page 31 for Map 1

adjacent states and provinces. For the purpose of reporting indicators, however, only the Montana portion of each region is considered. Finally, the environmental regions are much more than just an amusing exercise in regional geography; they serve a useful function by providing a natural geographical framework for organizing an otherwise complex and bewildering array of environmental condition and trend information. This is the sole reason for reporting data using Montana's environmental regions; the EQC is not encouraging the adoption of these regions to the exclusion of existing administrative land units.

The decision to report indicator data using environmental regions is ecologically sound but careful examination of Map 1 points out one problem. The environmental region boundaries do not coincide with the state's political subdivision into counties. Much data are available only on a county basis and this creates problems when attempting to report data using a different scheme. The EQC solution to this problem is not ideal as can be seen in Table 1, which lists by major class of data (socio-economic and biophysical) the assignment of counties to each environmental region.

Map 1 illustrates the existence of not one Montana, but two: Rocky Mountain Montana and Great Plains Montana. They have little in common other than a mutually shared seat of state government in Helena. They are divided by a line drawn northwesterly to southeasterly along the foot of the Rocky Mountain front. This schism accomplishes the first major division in the taxonomic hierarchy of Montana's environmental land units. Each subsequent division delineates an environmental region, which in turn may be divided into subregions.

ROCKY MOUNTAIN MONTANA is composed of three regions: Columbia Rockies, Yellowstone Rockies, and Broad Valley Rockies, listed in descending order,

NOTE: See page 31 for Map. 1, and pages 32 and 33 for Table 1.

according to water supply, timber productivity, and the boldness of their mountain scenery. This is the Montana most rich in water, forests, and minerals, but it is relatively poor in agriculture and fossil fuels. It is the historic and educational heartland of Montana.

Columbia Rockies is the most humid and heavily forested region of Montana. It is the most wild and unspoiled area of the state and ranks first in terms of timber supply, water production, and hydropower.

Ice Age glaciation was widespread and severe, resulting in high, rugged mountains and narrow, humid valleys. The climate is wet, drippy, snowy, and foggy. Heavy precipitation, voluminous rivers, and excellent dam sites in the region's narrow valleys are the basis for its tremendous hydroelectric production at Libby, Hungry Horse, Noxon Rapids, and Cabinet Gorge.

The Columbia Rockies contain one of the most luxuriant coniferous forests in the world. Here, in addition to species of the Rocky Mountain Douglas-fir forest type, are found western red cedar, western hemlock, grand fir, western white pine, and western larch in the montane zone and mountain hemlock and alpine larch in the subalpine zone. These comprise the basis of the important logging and wood processing industries of the region, though much of the timber is processed in the Broad Valley Rockies or in Idaho.

The region is sparsely populated. The small population is supported by logging, sawmilling, recreation, hydroelectric power production, and water supply activities--none of which is intensive. Most of the inhabitants, towns, and transportation corridors are concentrated in linear strips along the narrow valley bottoms. The valleys are too narrow for agriculture and the forests are too dense for grazing.

The massive mountain ranges separating the narrow valleys are almost entirely

enclosed in national forests. These include most of Montana's wilderness and other wildlands. As a result, the Columbia Rockies is one of Montana's cleanest and least spoiled environments.

Yellowstone Rockies is a mountainous area that lies between Yellowstone National Park and the Yellowstone-Clark Fork corridor. It is a highly scenic, relatively humid, rather densely forested region, thus an important source of recreation, timber, and water.

The region is dominated by four mountain ranges--the Madison, Gallatin, Absaroka, and Beartooth. Severely glaciated during the Ice Age, they possess a bold splendor that compares favorably with the best mountain beauty found elsewhere in the Rockies.

The Yellowstone Rockies is relatively uninhabited and is enclosed almost entirely by national forests. With the exception of the Paradise Valley--a broad, dry, irrigated valley similar to those of the Broad Valley Rockies--the valleys of the Yellowstone Rockies are too narrow to allow for farming or settlement.

The Yellowstone Rockies support a Rocky Mountain Douglas-fir forest type. Although similar species are found in the Broad Valley Rockies, forests in the Yellowstone Rockies are more dense, luxuriant, and productive due to more precipitation. It is an important log supply region, but most of the processing is done outside the region in Livingston, Bozeman, and Belgrade.

Broad Valley Rockies is that region of Montana distinguished by high mountain ranges separated by broad valleys. It is the most densely populated region within the entire Rocky Mountain system. The region is bisected by the Yellowstone-Clark Fork corridor and because of its dense population, complex economy, and diverse communication-transporation networks, it is considered Montana's "Main Street". The Broad Valley Rockies possess a great deal of

internal cohesion, resulting in a "pull" within the region toward the Helena-Butte core.

Three factors account for the region's dense population and complex economy. First is the spacing of the mountain ranges astride broad valleys. Second is the amount of precipitation. The mountain ranges are humid and the valley bottoms are dry. The third factor is the presence of mineralized rocks in the region, most of which are contained in the Boulder Batholith, centered near Butte.

Agriculture, both irrigated farming and livestock ranching, is important in the Broad Valley Rockies. The region's rough fescue prairie is better for grazing than the bluebunch wheatgrass community found on the steppe of Great Plains Montana. The mountainous portions of the region support a Rocky Mountain Douglas-fir forest type. In this forest biome, the principal climax species are Douglas-fir in the montane zone and subalpine fir-Engelmann spruce in the subalpine zone. While the region is better suited for grazing and less productive for timber supply than adjacent regions in Rocky Mountain Montana, it nevertheless supports a significant logging industry.

Outdoor recreation opportunities are plentiful and contribute to the economic diversity of the region. In addition to hunting and fishing, 12 of Montana's 27 skiing centers are located in the Broad Valley Rockies.

GREAT PLAINS MONTANA is composed of four environmental regions: Rocky Mountain Foreland, Sweetgrass Plains, Big Dry, and Two Rivers, listed in sequence from west to east. It is the more diverse of the two Montanas, containing a whole spectrum of land forms ranging from true plains to Rocky Mountain outliers. It is the Montana most rich in agriculture and fossil fuels but it is relatively poor in minerals, water, and forest products. In terms of wide open spaces and the traditionally rural western way of life, it is

perhaps the most characteristically "Montanan" of the two Montanas.

Rocky Mountain Foreland is, in terms of its dense population, complex economy, and diverse environments, the eastern counterpart of Broad Valley Rockies Montana. Several features combine to provide coherence to this environmental region. First, as its name implies, the Rocky Mountain Foreland is the land in front of the Rocky Mountains. Second is the existence of chinook winds. The third feature is foothills prairie, a more humid grassland than the short-grass steppe that originally covered most of Great Plains Montana. This constitutes the best nonirrigated grazing land in the state. Fourth, the region contains parklands consisting of open stands of ponderosa pine with a grassy understory. These parklands provide an excellent grazing resource, are exceptionally productive wildlife areas, and have a special esthetic quality not possessed by either treeless rangeland or continuous forest. Fifth is the Rocky Mountain outliers, the Snowy Mountains south of Lewistown, the Judith and Moccasin mountains north of Lewistown, the Highwood Mountains east of Great Falls, the Bearpaws and Little Rockies southeast of Havre, and the Bighorns, south of Billings. (Technically, the Bighorns are part of the main Rocky Mountain system but in Montana they are distinctly separate.)

The sixth distinctive characteristic of the Rocky Mountain Foreland is foothill ranching with upland summer grazing in the Rocky Mountains or mountain outliers. This enhances the importance of Billings and Great Falls as livestock centers. Seventh is the patches of dry-land farming scattered throughout the region. The most important grain producing areas in the Rocky Mountain Foreland are centered around Lewistown, Laurel, and Hardin. Eighth is the broad strips of irrigated agriculture based on the exotic mountain-fed streams flowing through the region. The most important of these are along the Yellowstone and

its tributaries the Clarks Fork and the Bighorn, and along the Sun, Teton, and Marias rivers. The last distinctive feature is the heavy but spotty population of the region. Population is sparse in the dry-land grain farming areas and very dense in the irrigated areas.

Fossil fuels production and beneficiation figure prominently in the economic makeup of the Rocky Mountain Foreland. It is the foremost oil refining region of Montana, with refineries located in Great Falls, Billings, and Laurel. Nearly all of Montana's coal exploration, mining, and thermalelectric power production takes place in this region.

Sweetgrass Plains is a major grain, petroleum, and natural gas producing region of the state. The landscape of the region is characterized by dry-land grain farming. Wheat is the principal crop but barley is of increasing importance. There is little irrigation and the grain crops are grown by the fallow system, with grain and fallow fields laid out in alternate north-south strips perpendicular to the prevailing winds.

The Sweetgrass Plains produces more winter than spring wheat because of the drier summers and less severe winters. It is the only large area of genuine plains in Montana.

The population of the region is moderately dense but the rural population and towns are more evenly distributed throughout the region than elsewhere in the state.

Human activity--cultivation, road building, drilling operations, and settlement--have so transformed the Sweetgrass Plains that few vestiges of the short-grass steppe that originally covered the plains of this region remain.

Big Dry takes its name from Big Dry Creek and is intended to suggest the forlorn character of this vast interior area of Montana. The region consists

of the genuine "cow country" that Easterners usually associate as typically Montana. The native perennial short-grass steppe has been greatly modified on the vast expanses of rangeland covering most of the region. Most of the region's population and towns are concentrated along the narrow irrigated strips in the valleys formed by the Milk and Yellowstone rivers. There is more public land in the Big Dry than in any other region of Great Plains Montana. Most of these lands are leased for grazing.

The state's most productive oil and gas field is located here, the Bell Creek Field southeast of Broadus. Other important producing areas lie northeast of Roundup at Sumatra and northeast of Malta at Bowdoin.

The natural features of the Big Dry have been extensively modified by grazing, cultivation, irrigation, and mineral fuels extraction. Nevertheless, the Big Dry's vast horizons and wide open spaces have a special esthetic quality unmatched by any other region of Montana.

Two Rivers gets its name from the convergent alignment of the Yellowstone and Missouri rivers. The region lacks the chinook winds present in other areas of Great Plains Montana. As a result, it is colder and grows mainly spring, rather than winter, wheat. Along the irrigated farmland near the Yellowstone and Missouri rivers is grown substantial amounts of sugar beets, dry beans, and potatoes.

The region is a petroleum producing areas with major supplies from the Cedar Creek Arch, which extends from Baker to Glendive, as well as from the four counties in the northeastern corner of the state.

The terrain of the region is relatively rough, which results in a smaller portion of the land under cultivation than in the Sweetgrass Plains. North of the Missouri the area is till-covered plateau; south of the Yellowstone, plains

and widely spaced hills; and stream-dissected plateau between the two rivers.

Selecting Montana Environmental Indicators

Three general principles guided the EQC staff selection of indicators to be included in the Fourth Annual Report. The first was that whenever feasible those indicators reported in the First Annual Report (1972) should be used. This would provide some continuity between the two reports and establish a firmer basis for examining trends taking place in the Montana environment. The second was the decision to extend the coverage of indicators to include data reflecting socio-economic conditions in the state. The First Annual Report focused exclusively on the biophysical side of the Montana environment. The inclusion of socio-economic indicators in the Fourth Annual Report was based on the belief that not only do people and human activities have a profound impact on the environment but they are also an integral part of the environment. The third principle was that the indicators should be judiciously selected so as not to pollute or overload the information atmosphere. The objective was to choose indicator data that would allow decision makers and citizens to examine the major man-nature interactions taking place within the state in a systematic, understandable, and efficient manner.

The EQC staff began by assembling all the data currently collected by state and federal agencies that reflected aspects of Montana's environment and quality of life. This yielded a staggering amount of data. No less than 13 of the 19 departments of state government and some 18 federal agencies routinely produce data that reflect environmental trends and conditions. It was quickly discovered that while these data might be useful for the agencies collecting them, they could not all be incorporated into the EQC report. Additonally, it

was noted that some data illustrating important environmental trends were not being collected. In this instance, it was decided that attempting to collect new data was beyond the EQC's capability; the initial effort would use existing data only.

This effort to produce a coherent picture of the environmental monitoring activities now being routinely conducted in the state resulted in the preparation of a monitoring directory--Environmental Monitoring in Montana. This guide has been published in chart form and is available separately and as an insert in the Fourth Annual Report. In order to display the various environmental monitoring activities so that they would correspond more closely with the format of the Fourth Annual Report, the current listing of monitoring activities were aggregated into four major classes--people, natural resources, the natural environment, and the man-made environment. Table 2 identifies the major factors for which data are available in each of the major classes. For each factor a short description gives the following additional information: specific parameter/indicator, dimension, frequency of measurement, data collection locations, current statistical uses, data storage and publication, and agency contact.

Using the information contained in the monitoring directory, the EQC staff selected the indicators to be included in the Fourth Annual Report using four criteria: 1) availability of monitored data; 2) extensive coverage, preferably statewide; 3) reflect real environmental trends and conditions; and 4) relevance to environmental policy making and program administration. Table 3 lists these selected indicators and their unit of measurement. The Fourth Annual Report contains a discussion of these indicators for the entire state and for each of the state's seven major environmental regions.

NOTE: See page 34 for Table 2, and page 35 for Table 3.

Indicators Statewide: An Overview of Major Findings

As noted previously, the EQC Fourth Annual Report contains data covering some 30 indicators. These indicators were selected, using the criteria described above, in the belief that they revealed certain trends and assessed certain conditions relative to the state's diverse and complex environment. Only major statewide trends and conditions are summarized here, though the Fourth Annual Report details conditions and trends for each of the state's environmental regions.

- Demographic Trends. Given its vast land area (93,089,323 acres), Montana's population is small (734,800 in 1974) and not very dense (4.84 people per square mile in 1974). The distribution of Montana's population is continuing the pattern discernible since the 1930s, with the number of people living in urban areas increasing (more than 50 percent live in cities and towns), the number of people living outside urban areas but not engaged in agriculture also increasing (over 30 percent in 1970) and the number of farm families declining (less than 15 percent in 1970). Important information is obtained by examining population changes as a function of in- and out-migration and births minus deaths. For the 1950-1970 period, more people left the state than entered it. Data collected for the 1970-1974 period, indicate this trend may be changing: the 6 percent population increase for the 1970-1974 period is divided about evenly between new births and the in-migration of 20,000 people.

- Energy Resource Trends. Montana is an energy producing and exporting state. The future of coal strip mining and its conversion within the state to electricity and possibly synthetic gas are perhaps the critical energy issues facing the state. Montana has the largest deposit of economically recoverable coal in the United States, some 15 billion tons. Production of coal in the

state has increased from 3.5 million tons in 1970 to over 22 million tons in 1975. Montana annual coal production is projected to be 28.6 million tons in 1976 and 42.8 million tons in 1980.

Oil production in Montana has been decreasing, from 37.9 million barrels in 1970 to 34.6 million barrels in 1974. Natural gas production has exhibited erratic patterns: 36.7 billion cubic feet in 1970, 34.9 in 1972, 57.7 in 1973, and 50.4 in 1974, the increase in the last two years due to opening of the Tiger Ridge Field. Except for the low run-off year of 1973, hydroelectric power generation has remained relatively constant at about 9.5 million megawatt hours.

A number of critical issues surround energy development in Montana. The major issue, of course, involves coal mining and conversion. Unresolved issues relate to such matters as assessing the impact on the state of the resumption of federal coal leasing, problems of reclaiming disturbed lands, the impacts of coal development on rural lifestyles, the allocation of water resources between industrial, municipal, agricultural, and aquatic habitat uses, and the relationships between greatly increased coal-based tax revenue and the state's taxing and spending policies. (The state Department of Revenue projects that $22.5 million will be generated in coal tax revenues during FY 76 and an additional $38.3 million during FY 77.) Another major issues concerns the state's dependence on Canadian natural gas and oil and the gradual elimination of these supplies. Determining whether in-state sources exist and whether new discoveries and/or improved recovery techniques at present Montana sites can overcome the shortfall is an urgent matter. Current efforts to examine the feasibility of constructing a synthetic gas facility in the state should be complemented by examining energy source alternatives for those industries threatened by the Canadian gas phase-out. And, of course, energy conservation should be a

perennial goal of all sectors of society for the purpose of minimizing consumption of non-renewable fossil fuels.

● Agricultural Land Trends. Data accurately reflecting changes in the use of Montana's most important economic resource--soil--are difficult to obtain. The EQC used three major data sources in preparing its Fourth Annual Report: the Natural Resource Lands Digest compiled by the BLM, the U.S. Department of Commerce Census Bureau's Census of Agriculture, and the Montana Soil and Water Conservation Needs Inventory prepared by the Soil Conservation Service. The major deficiencies in these data are that they are not current and they use widely divergent definitions in classifying different agricultural land uses.

Using the Census of Agriculture classifications, land in agriculture in Montana amounted to 61.2 million acres in 1969, a decrease of 400,000 acres since 1959. This figure excludes some 900,000 acres of BLM-managed agricultural land for which 1959 data are unavailable. The SCS data revealed 58.4 million acres classified as cropland, pasture, and range in 1967. This was a 1.9 million acre increase over their 1958 figure. The BLM reported an additional 8.9 million acres of cropland, pasture, and range under their management in 1967. With higher grain prices over the last few years, the SCS estimates that at least 250,000 acres have been converted from range to marginal cropland since 1969.

● Forestland Trends. Data for Montana forestlands suffer the same kind of problem as data for agricultural land. Forestland is divided by principal owner: state and private, and the U.S. Forest Service. In 1967, the last year for which data are available, there were slightly more than 7 million acres classified as forestland in state and private ownership. Of this, 6.1 million acres were considered commercial quality. The U.S. Forest Service had 12.6 million acres

of forestlands in 1974, of which nearly 8 million acres were considered commercial. Excluded from the Forest Service figure is land in reserved or wildland classifications. No accurate trend exists for these wildlands. Although the last few years have witnessed significant additions to the National Wilderness Preservation System in Montana, encroachment by a number of human activities has probably reduced the non-classified roadless areas. A recurring issue related to public lands in Montana is the question of public access.

● Water Use Trends. According to data collected by the Montana Department of Natural Resources and Conservation in 1970, Montana's total annual surface water supply amounted to 43,899,580 acre-feet per year (afy). In 1970, all water withdrawals amounted to nearly 13 million afy, with about 6 million afy of that consumed and 7 million afy returned to the streams. About 31 million afy was available for instream uses. These data oversimplify a complex water use situation that exhibits significant regional variation in water use patterns. However, statewide, and in each of the seven environmental regions, the major consumptive use of water is irrigation. Locally intense consumptive water use has serious implications for water quality, aquatic habitat, and other instream values.

● Minerals Production Trends. In 1974 the value of minerals produced in Montana exceeded $500 million. A major determinant of minerals production in the state is the price they yield. Gold production has been on the increase, from 22.5 thousand troy ounces in 1970 to 28.0 thousand troy ounces in 1974. Silver has exhibited radical fluctuations: 3.3 million troy ounces in 1972, 4.4 million troy ounces in 1973, and 3.6 million troy ounces in 1974. Zinc and lead production has been generally declining. Only 130 short tons of lead were produced in 1974, compared with 4,538 short tons in 1964. From 1964 to

1970, zinc production declined from 29,059 short tons to 1,457 short tons. Copper production, the mainstay of Montana's minerals sector, has increased steadily to over 125,000 short tons in 1974.

Montana's mining industry has been historically unstable. With corporate control located outside the state, with production tied closely to price fluctuations, and with most of the metals finishing taking place elsewhere, some observers have questioned whether the mining industry has been a good Montana citizen. The history of old mining camps in the state attest to this. The economic benefits of mining to the state need not be questioned; nonetheless, mining activities have caused severe environmental problems as well as creating substantial social disruption.

The future may see accelerated mining activity in the state as the general demand for more minerals increases and as the reliability of foreign sources of supply becomes more uncertain. Uranium mining may be undertaken should Montana's low-grade sources be needed to support a U.S. energy policy relying on nuclear generated electricity. New or proposed mines have been identified at Troy (copper and silver), Dillon (iron), and Nye (platinum and palladium). Interest has been expressed in phosphate in the Gold Creek area and in potassium in Daniels County. These developments need to be monitored closely.

● Wildlife Trends. Rather than report population trends for only a few game animals, the EQC Fourth Annual Report selected avian diversity as an indicator of ecosystem integrity, assuming species diversity and ecosystem integrity are inextricably interrelated. Game and non-game birds comprise a significant portion of Montana's diverse fauna: over 350 species. The annual breeding bird inventories, conducted largely by Audubon Society members and reported by the U.S. Fish and Wildlife Service, represent the only comprehensive

wildlife monitoring effort conducted in Montana. In addition, data are reported on the number of mourning doves and starlings counted annually from 1968 to 1974. The mourning dove is very sensitive to chemical contamination; the starling, an introduced species, is a good indicator of garbage contamination, crop damage, and urban degradation. Since 1968 the number of mourning doves has declined and the number of starlings has increased.

• Air Quality Trends. Montana has six significant air pollution problem areas: Columbia Falls, Flathead Valley, Missoula, Billings, Anaconda, and the Helena Valley. Other areas having air pollution problems are Great Falls, Philipsburg, Libby, and Garrison. Under criteria established by the federal Clean Air Act, Montana has five Air Quality Control Regions, surrounding the cities of Billings, Great Falls, Missoula, Helena, and Miles City. While in general air quality in each region has improved, only the Billings region met federal ambient air standards by the May 1975 deadline. Of the approximately 100 industrial plants classed as major air pollution sources, it is believed nearly three-fourths are in compliance with the state air pollution control plan.

These generally improving air quality trends may produce a deceptive sense of well being because vast areas of the state are susceptible to excessive particulate and dust pollution and are not now being monitored. The major challenges facing Montana in air pollution control are the more elusive sources, such as automobiles in urban areas, slash burning, dusty roads and streets, open burning dumps, large parking lots, and the prevention of significant deterioration.

• Water Quality Trends. Two water quality indicators are reported: population delivered unsatisfactory drinking water and point and non-point source degradation of Montana streams. Drinking water quality, measured by bacteriological standards, has been improving. In 1971, 7 percent of the state's

population was served unsatisfactory water. That figure dropped to 3.8 percent in 1974. Point source stream degradation (miles of streams affected by the discharge of raw sewage and untreated industrial wastes) was a major water pollution problem in 1961, when over 1,044 miles of streams were affected by point source pollution. That was reduced to 251 miles in 1975.

Pollution from non-point sources is currently the state's major water pollution problem. Non-point source pollution primarily results from manipulating the land to produce crops, livestock, timber, and minerals. Non-point sources presently affect nearly 3,500 miles of streams in Montana. Without appropriate conservation measures, conversions of range to marginal cropland and dryland to irrigated cropland will result in substantially more stream miles degraded by non-point sources.

Under Section 208 of the 1972 Federal Water Pollution Control Act Amendments, the state must identify non-point sources of water pollution and adopt land use measures designed to control non-point source pollution. This is an activity that bears careful monitoring.

- Land Quality Trends. Land is Montana's most valuable natural resource. Crop, livestock and timber production are land-based activities, which, if properly managed, can be sustained indefinitely. The demand for food, fiber, and wood products will continue to increase into the foreseeable future, placing tremendous strains on Montana's land base. Using data compiled by the Soil Conservation Service, over 32 million acres of the state's 58 million acres of cropland, range, and pasture in private and state ownership required some type of conservation treatment in 1967, ranging from alternative land use on some dry cropland, to protection from grazing for much of the range and pasture. This same assessment calculated that 61 percent of the private forestlands in Montana

were in need of either establishment and reinforcement (tree planting) or timber stand improvement (tree thinning). In 1968, it was estimated that 6 percent of the 14 million acres of forestlands in federal ownership needed some conservation treatment. Of the range and pasture in federal ownership (mostly BLM), some 62 percent, or 6,800,000 acres required treatment.

A 1963-64 BLM inventory classified range conditions into excellent, good, fair, poor, and bad categories and range trends into static, improving, and declining categories. (Range conditions are based on plant species composition and soil surface factors. A "fair" rating means the land has unsatisfactory top soil and plant coverage; a "poor" rating indicates heavy top soil loss, poor forage conditions, and varying degrees of erosion.) In 1963-64, 51 percent of BLM rangeland was classed good or excellent, 42 percent fair, and 7 percent poor or bad. The range trend (an indicator of changing range conditions) revealed that 77 percent of the BLM rangeland was static, 13 percent was declining, and 10 percent was improving.

The Soil Conservation Service reported in 1974 that nine million acres of previously unfarmed land underwent cultivation nationally. An additional nine million acres were plowed in 1975. Between 75,000 and 100,000 acres were so converted in Montana in 1975, according to the Agricultural Stabilization and Conservation Service.

The Montana Department of Natural Resources and Conservation reports that about 2.1 million acres were irrigated in Montana in 1975 with 112,000 additional acres planned for irrigation in 1976-77. Based upon red meat demands and constraints in rangeland production, between 600,000 and 2 million additional irrigated acres would be required in the state by the year 2000.

These range-to-marginal-cropland and dryland-to-irrigated land conversions

could pose serious environmental problems from the standpoint of soil loss by wind and water erosion, degraded air and water quality, and loss of aquatic habitat. In addition to environmental impacts, irrigation consumption of water will intensify competition for remaining water resources, make the remaining water more costly, and thereby affect future irrigation opportunities.

Nothing underscores more the importance of updating and improving data on the changing quality of Montana's land base. The absence of accurate current data and the lack of clear land conservation policies may result in irreversible modification of this critical resource.

● Trends in the Man-Made Environment. A comprehensive examination of Montana's environment would be incomplete if it did not attempt to explore the "people" side of the environment. Quality of life cannot be measured in natural amenities alone; it must also reflect the individual's day-to-day environment. The Fourth Annual Report does not attempt to define quality of life in the Montana context nor does it present an explicit rationale for computing such an all encompassing index. What is provided are some socio-economic measures that can be used to evaluate the other facet of Montana's environment and to identify areas of concern for citizens and communities.

As a gross indicator of health and health care delivery, perinatal death rate trends were selected. Based on the number of deaths per 100 live births, that indicator showed steadily improving conditions, from 3.09 deaths per 100 live births in 1965 to 2.27 in 1973.

To indicate community stability and personal safety, offenses reported to police was used. Calculated as the number of reported crimes per 100 population, this indicator has steadily increased, from 3.2 per 100 in 1972 to 4.0 in 1974.

The report includes a wide variety of indicators that reflect Montana

employment and income trends, perhaps the clearest and most direct indicators from the standpoint of an individual's physical well-being. Major data sources for these indicators are the Employment and Security Division of the Montana Department of Labor and Industry, the U.S. Department of Commerce Census Bureau and Bureau of Economic Analysis, and the University of Montana Bureau of Business and Economic Research.

Between 1968 and 1973, Montana's employment grew nearly 14 percent, adding 37,700 jobs to the state's economy. More than 34,000 of these were added in the private non-farm sector, with new government jobs contributing 4,000. The farm sector lost about 1,200 jobs, declining from 14.5 percent of the total workforce in 1968 to 12.4 percent in 1973. The Montana Department of Labor and Industry estimates that 17,000 new jobs were added in 1974. While many jobs were added during this period, the state's unemployment rate also increased, from 5.6 percent in 1970 to 6.7 percent in 1974, indicating that people were entering the labor force faster than jobs were being created. While unemployment is a serious issue in Montana, it should be noted that Montana's unemployment rate has historically exceeded the national average but for most of 1975 it was below the national average.

A traditional measure of economic well-being is per capita income. Calculated in 1968 constant dollars, Montana performed remarkably well during the 1968-1973 period, when real per capita income increased 12 percent in Montana ($3,428 in 1973) as compared to 5 percent nationwide ($3,632 in 1973). From 1972 to 1974, Montana's real per capita income declined 11 percent to $2,889, which was slightly less than the national decline of 12 percent ($3,196). It should be noted, however, that the gap between Montana's per capita income and the national average has been closing, from 16 percent below in 1968 to

9 percent below in 1974.

Some interesting economic trends are revealed when earnings per employee by sector (farm, government, and private non-farm) are examined. In 1968, earnings per employee in the farm sector was $5,045. That figure steadily increased to $12,314 in 1973. Earnings per employee in the government sector increased slightly, from $5,712 in 1968 to $6,007 in 1973. Earnings per employee in the private non-farm sector declined, from $5,850 in 1968 to $5,222 in 1973, perhaps reflecting a greater number of lower paying, service-oriented jobs.

Two additional indicators show improving conditions for Montana's families earning low incomes. In 1960, 20.2 percent of families in the state earned less than $3,000 per year; in 1970, 16.0 percent earned less than $4,000 per year. The number of children added each year to the state's Child Welfare Services is another indicator of increasing income stability and more equitable distribution to lower income groups. In 1970, over 2,700 children were added, compared with 2,052 in 1974.

The report also includes data on circulation of library holdings per capita. Public libraries are an important community resource. Library holdings provide patrons a ready source of current books and magazines and offer unlimited educational and personal growth opportunities. In 1966 and 1974, library circulation per capita in the state was 4.86, reaching a low of 4.48 in 1970 and a high of 5.07 in 1972.

Given the state's vast area and diffuse population, highway transportation assumes great significance in Montana. There are large areas of the state not served by rail, airline, or bus and which are distant from the main network of highways. The Fourth Annual Report does not focus on the major highway network--

the state's primary and secondary highways. Instead, to provide an indicator that reflects a better balance between urban and rural roads and the major highway network, the report considers the "capillary system" of county and local roads, which provide the rural population with access to the main system. The indicator used is the rural area and rural population served per mile of rural road. Using 1970 data, the indicator was derived by determining the number of miles of rural roads in the state and comparing that figure to the rural area and rural population served by that system. Only rural roads and rural population are considered. In 1970, each mile of rural road served a 2.27 square mile rural area and 5.13 rural people.

Utilizing the Results

Publication of any report gives the illusion of finality and permanence. The EQC wishes to emphasize that its Fourth Annual Report seeks to initiate a process, which over time will be developed into a system for reporting periodically current trends and conditions of Montana's environment. While not precluding immediate application, this means the report is tentative and exploratory. Much remains to be done. Some readers will be disappointed that the report fails to identify specific or local environmental problems and to evaluate the significance and meaning of the indicators. This omission was purposeful. It is hoped that users of the report will draw their own conclusions about the implications of the information contained in the report and emerge with a clearer understanding of the opportunities and obstacles for obtaining a high quality of life in the Montana context. Readers will no doubt find some of the indicators obscure, others irrelevant. Other readers will note the absence of data for factors they consider important for identifying environmental trends and

conditions in the state. The EQC hopes such assessments will be forwarded to them for use in preparing subsequent editions.

It should be noted that the data reported in the Fourth Annual Report are collected by other agencies, often for purposes not associated with the objectives of the EQC indicators program. In order to improve the EQC reporting system, information is required from users on what their data needs are. Once these are determined, recommendations to the agencies collecting the primary data can be made to modify existing monitoring activities and/or to initiate additional ones.

Conclusion

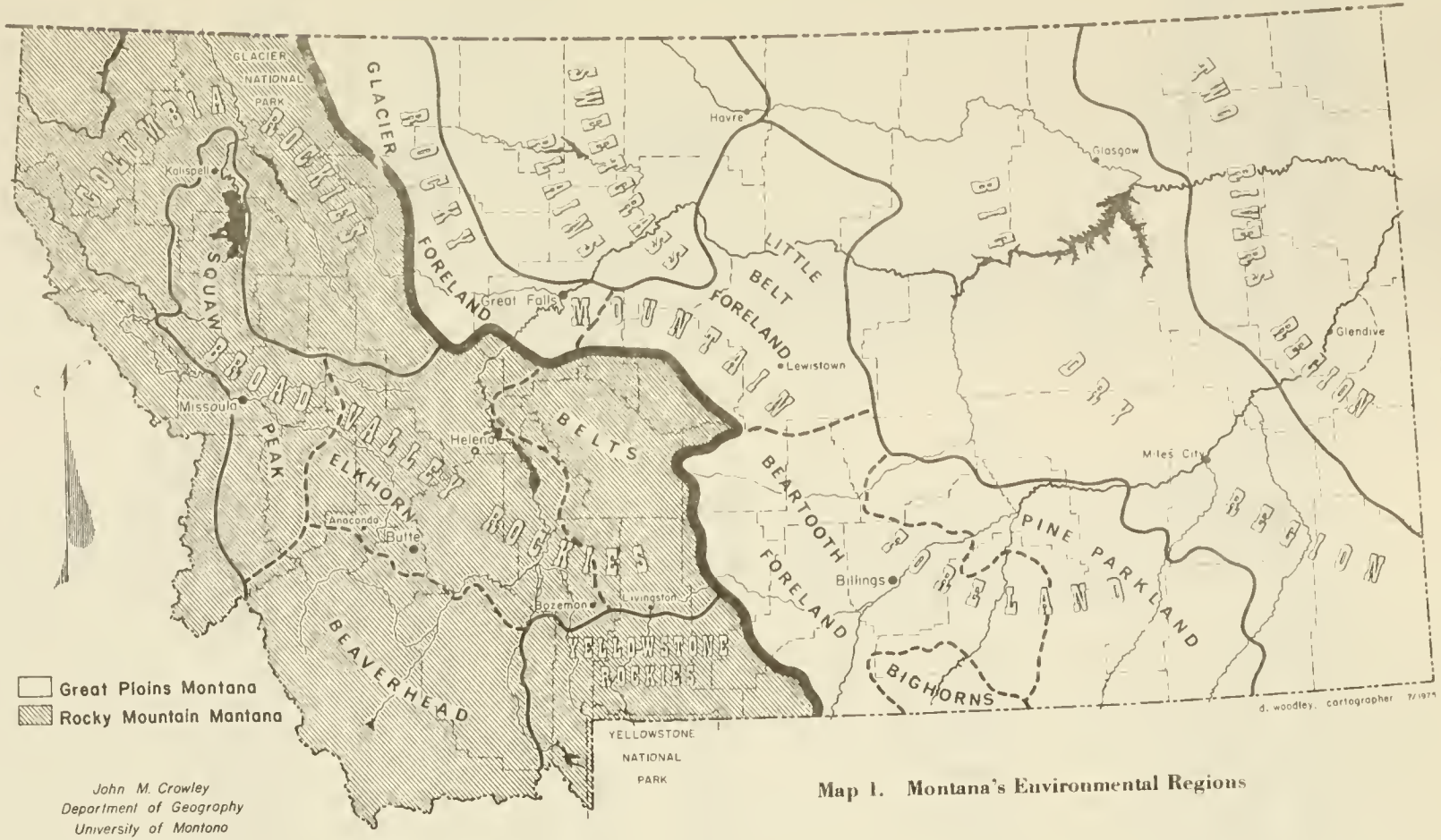
The Environmental Quality Council believes its Fourth Annual Report is a policy-relevant document. It contains data from which judgments about the state of the state's environment may be made. It was designed to give citizens and decision makers a better grasp of the state's complex and diverse environment. That enhanced understanding ought to be reflected in the decisions each makes affecting the allocation of natural and human resources in Montana.

Since its creation in 1971, and throughout all of its report, the EQC has maintained that no greater challenge confronts the citizens and leaders of Montana than identifying what it is about the state that makes Montana a good place to live and establishing policies and designing programs to maintain and protect those characteristics through democratic processes. Forces are at work that unchallenged and unmanaged will destroy those things most citizens associate with why they are here and why they choose to remain. Sensitively used, the EQC Fourth Annual Report can be of considerable assistance in the difficult and complex process of finding out where we are,

discovering where we want to go, and doing what is required to enhance and protect those things we cherish.

Appended to the EQC First Annual Report was a statement entitled "An Environmental Quality Premise for Montana." That premise aptly outlines the challenges facing all Montanans to make Montana a fit place to live, now and in the future. It is a fitting frame of reference from which to assess the role of the EQC indicators program:

> Montana has perhaps the last great reserve of high quality living space left in the United States. Endowed with abundant natural resources, this may be our most valuable resource. This priceless environmental heritage remains unblighted to a degree undreamed of elsewhere in this country.
>
> Montana still possesses a quality of life and a quality of natural living space which will be forever unattainable in other states ravaged by the destructive development of earlier eras.
>
> Montana yet has the unique opportunity of arresting its localized environmental cancer and restoring the health and productivity of the infected areas. Pollution has not yet become so pervasive in our state as to irreversibly impair the life-supporting natural systems which sustain human life and wildlife alike.
>
> Health is the capacity for self-renewal. Montana still retains unimpaired this capacity for self-renewal of its natural communities of plants and animals. The natural systems of air, water, and soil on which they depend remain essentially intact.
>
> While the living ecosystems of the state still maintain their integrity, we can elect to harmoniously intermesh human technology with the systems of nature in a sustained and productive coexistence. Sustained economic productivity is dependent upon maintained environmental integrity.
>
> People and corporations are going to discover this state. Quality attracts quality. Our efforts to maintain environmental quality will assure that we attract those people and corporations who will add most to the life of the state.
>
> Montanans have both the ability and the determination to go beyond repair and restoration. We have a fleeting opportunity to enhance the livability of our environment.
>
> We are now aware, as earlier generations in other places were unaware, of the interdependent links between a healthy natural environment and human well-being.



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Map 1. Montana's Environmental Regions

Table 1. Distribution of Counties within Montana's Environmental Regions

Region	Socio-economic Data Counties	Biophysical Data Counties
Broad Valley Rockies	Beaverhead* Broadwater* Deer Lodge* Flathead Gallatin Granite* Jefferson* Lake Lewis and Clark Madison Meagher* Missoula Park Powell Ravalli Silver Bow*	Includes all socio-economic counties <u>except</u>: Flathead Park
Columbia Rockies	Lincoln* Mineral* Sanders	Flathead Lincoln Mineral Sanders
Yellowstone Rockies	***	Park
Rocky Mountain Foreland	Big Horn* Carbon Cascade Fergus Golden Valley* Judith Basin Musselshell Rosebud Stillwater Sweet Grass Teton Treasure Wheatland Yellowstone*	Includes all socio-economic counties <u>except</u>: Glacier Powder River <u>Plus</u>: Rosebud

Table 1. Distribution of Counties within Montana's Environmental Regions (continued)

Region	Socio-economic Data Counties	Biophysical Data Counties
Sweetgrass Plains	Chouteau Glacier** Hill Liberty* Pondera Toole*	Includes all socio-economic counties except: Glacier
Big Dry	Blaine Carter* Custer* Garfield* Petroleum* Phillips* Powder River Prairie Valley	Includes all socio-economic counties except: Powder River Plus: Rosebud
Two Rivers	Daniels* Dawson* Fallon McCone Richland* Roosevelt* Sheridan* Wibaux*	Same as socio-economic counties

*Core Counties: environmental regions includes all or nearly all of county population and land area within the region.

**Only the county seat (Cut Bank) and a small portion of rural area is included in Sweetgrass Plains.

***The environmental regional boundaries are such that the major population centers lie outside the Yellowstone Rockies. Socio-economic indicators are therefore incorporated into either the Broad Valley Rockies or the Rocky Mountain Foreland.

Table 2. Environmental Monitoring in Montana

Class	Factor
PEOPLE	Population
	Migration
	Distribution
NATURAL RESOURCES	Agricultural Land
	Surface Water
	Ground Water
	Water Use
	Energy
	Minerals Reserves
	Minerals Extraction
	Wild Lands
	Timber
NATURAL ENVIRONMENT	Ambient Air Quality
	Surface Water Quality
	Ground Water Quality
	Condition of Wildlife
	Land Quality
MAN-MADE ENVIRONMENT	Economy
	Transportation
	Housing
	Health
	Health Related Systems
	Social Health
	Industrialization/Urbanization

Table 3. Montana Environmental Indicators: 1975.

Indicator	Unit of Measurement
Population Size	Number
Population Density	Number Per Square Mile
Population Distribution	Percent Distribution by Sector
Population Change	Percent Change
Energy Production	Variable
Energy Reserves	Variable
Agricultural, Forest, and Wild Lands	Acres
Water Withdrawals and Consumption	Acre-Feet Per Year
Minerals Production	Variable
Wildlife Health	Breeding Bird Diversity
Air Quality	Variable
Water Quality	Population Served Substandard Drinking Water Stream Miles Degraded
Agricultural Land Quality	Acres Needing Conservation Treatment
Forestland Quality	Acres Adequately Stocked
Health	Perinatal Death Rate County Health Status Index
Crime	Offenses Known to Police
Employment	Employment by Sector Employment Ratio/Unemployment Rate
Income	Per Capita Income Earnings Per Employee Low Income Families
Library Access	Circulation Per Capita
Social Welfare	Additions to Child Welfare Services Case Load
Rural Road System	Area and Population Served Per Mile